REMARKS

The Office Action dated March 26, 2004 has been received and its contents reviewed. By this amendment claim 3 has been amended, claim 5 has been cancelled and claims 6-8 have been added. Accordingly, claims 3, 4 and 6-8 are pending in the present application, of which claim 3 is independent.

On page 2 of the Office Action, the examiner acknowledges Applicant's claim for priority but also indicates that a certified copy has not been filed in the case. Applicant however respectfully submits that the priority document was provided in the parent application (09/931,190) of the present application. Accordingly, Applicant requests acknowledgement and acceptance of Applicant's priority claim.

Also, on page 2 of the Office Action, the title of the invention was objected to as being non-descriptive. By the present amendment, the title has been changed to provide a better description of the invention. Accordingly, Applicant respectfully request reconsideration and withdrawal of the objection.

Turning now to the rejections, claims 3 and 5 are rejected under 35 U.S.C. § 102(e), as being anticipated by U.S. Patent No. 6,181,012 to Edelstein, and claim 4 is rejected under 35 U.S.C. § 103(a), as being obvious over Edelstein in view of U.S. Patent No. 6,077,782 to Hsu. Each of these rejections is respectfully traversed for at least the following reasons.

The present invention, as currently set forth in independent claim 3, is directed to a method for manufacturing a semiconductor device. A recess is formed in an insulating film on a substrate. A first conductive film is deposited to be in contact with a bottom and side surface of the recess. The first conductive film comprises a copper alloy including at least one of Al, Si, Ir or Ru. A second conductive film is formed on the first conductive film by an electroplating method so as to fill the recess. The second conductive film comprises copper. The first and second conductive films are integrated into a third conductive film so as to form wiring of a third conductive film. Therefore, the second conductive film can be formed on a first conductive as a seed layer to prevent generation of filling defects and degradation in reliability of a wiring. (see specification, page 6, line 11- page 8, line 20).

Furthermore, the first conductive layer set forth in the present invention comprises a copper alloy including in at least one of elements Al, Si, Ir or Ru. The claimed structure provides a layer with high resistance to electro-migration and excellent adhesiveness. Applicant notes that Al, Si, Ir or Ru are oxidized easier than Cu. The tendency of oxidation

is calculated by using the free energy of formation, and some examples are shown in below:

The free energy of Cu_2O formation : -75 cal/g.;
The free energy of SiO_2 formation : -197.5 cal/g.; and
The free energy of Al_2O_3 formation : -260 cal/g.

Namely, Al and Si are oxidized easier than Cu, and Ir and Ru also have similar amount of free energy as Al or Si. Therefore, adding Al, Si, Ir or Ru to Cu film better prevents oxidation of Cu film. Additionally, Ru and Ir maintain conductivity if these atoms are oxidized. As a result, the method of the claimed invention prevents oxidation of Cu film as a conductive layer and improves electroplating by maintaining the conductivity of the first conductive film, which includes Al, Si, Ir or Ru.

Turning now to the rejected claims, Applicant respectfully submits that Edelstein fails to disclose depositing a first conductive film in contact with a bottom and side surface of the recess, as now set forth in independent claim 3. Instead, Edelstein discloses that a seed layer is deposited onto an underlying barrier layer, which may contain material such as Ti, Nb. Mo, Ta, TaN, W, WN, TiN, TaSiN, WSiN, TiAlN, TiSiN (column 9, lines 26-30). However, Edelstein fall to disclose the structure having no barrier layer. Accordingly, Applicant respectfully submits that Edelstein does not teach each and every feature of the present invention. As each and every limitation must be disclosed or suggested by the cited prior art reference in order to establish anticipation, reconsideration and withdrawal of the rejection are respectfully requested.

Additionally, dependent claim 4 is rejected under 35 U.S.C. § 103(a) as being unpatentable over Edelstein in view Hsu. For the following reasons, Applicant respectfully traverses this rejection for the following reasons.

With regard to dependent claim 4, the step of depositing the first conductive film (discussed above with regard to independent claim 3) includes the step of depositing the first conductive film with (111) orientation with respect to the bottom of the recess. As a result, the second conductive film can be formed on a first conductive as a seed layer to prevent generation of filling defects and degradation in reliability of a wiring (see specification, page 25, line 16 to page 27, line 4 for example).

Another advantage of the present invention resides in the fact that the first conductive layer is located between an insulating film and copper film and provides excellent adhesion

qualities with both layers, even though copper normally does not easily adhere to an insulating film. First, the first conductive layer has excellent adhesion with a Cu film or Cu alloy film as a conductive layer due to each layer having the same constituent element. In other words, the claimed first conductive layer and a the second conductive layer of the present invention have similar crystal structure, so it is advantageous to form Cu layer as a conductive layer by electroplating when both layers have the same orientation (111). Additionally, the first conductive comprised of a Cu alloy film including in at least one of elements Al, Si, Ir or Ru has excellent adhesion with the insulating film (especially an insulating film containing carbon set forth in dependent claim 7) since Al, Si, Ru or Ir can react with the insulating film since they have a higher reduction than Cu. Namely, the structure is formed easily by the reaction between Al, Si, Ru or Ir and the insulating film so the adhesiveness between the claimed first layer and the insulating film is increased.

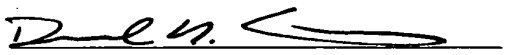
Turning to the rejection, as discussed above, Edelstein fails to disclose depositing a first conductive film in contact with a bottom and side surface of the recess and Hsu does not appear to solve this deficiency. Additionally, Applicants submit that neither Edelstein nor Hsu disclose a conductive film with (111) orientation used as a seed layer as set forth in dependent claim 4. Hsu also fails to disclose forming a seed layer directly on the recess formed in an insulating film. Instead, Hsu merely discloses the orientation of Al, Ti (barrier layer) or TiN (column 3, lines 6-13 of Hsu). Additionally, Hsu does not focus on the orientation which the copper alloy film has and that Cu film is formed on the Cu alloy film having predetermined orientation. Hsu does not describe or provide suggestion regarding the orientation matching between the conductive layer comprised of Cu and the seed layer comprised of Cu alloy including in Al. Si, Ir or Ru. Accordingly, Applicant respectfully requests reconsideration and withdrawal of the rejection.

The remaining dependent claims 6-8 are allowable for at least the reasons discussed with regard to independent claim 3, as well as for reasons of their own.

Thus, Applicants submit that the claims in the present application are allowable over the prior art of record and respectfully request reconsideration and allowance of the present application.

Should the Examiner believe a conference would be of benefit in expediting the prosecution of the instant application, he is hereby invited to telephone counsel to arrange such a conference.

Respectfully submitted,



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